REMARKS

Claims 1-5 are pending herein and have been amended hereby to correct matters of form. Applicants respectfully submit that no new matter has been added. Attached hereto as pages 6-7, pursuant to Rule 1.121(c)(1)(ii), is a marked-up version of the amended claims.

1. The objection to the title is noted, but deemed moot in view of the new title submitted in the substitute specification.

2. The objection to the drawings is noted, but deemed moot in view of the Submission of Amended Drawing filed herewith.

3. The objection to claim 2 is noted, but deemed moot in view of rewritten claim 2 submitted above.

4. Claim 1 was rejected under §102(b) over Weiss. Since claims 2-5 are also discussed on pages 3 and 4 of the Office Action, Applicants presume that the Examiner intended to reject all of claims 1-5 under §102(b) over Weiss. In any event, however, Weiss fails to disclose or suggest the features recited in the pending claims.

With reference to Fig. 1 of the present application, the presently claimed invention relates to an absolute value calculating element that includes an actuator (2) formed from a plurality of disk-like shaped electrostrictive elements (1). Detecting means (3), such as a piezoelectric/electrostrictive element, is coupled to the actuator (2). An AC signal supplied to the electrostrictive elements (1) of the actuator (2) causes the actuator (2) to deform. This deformation in turn causes the piezoelectric/electrostrictive element (3) to deform. Deformation of the piezoelectric/electrostrictive element results in creation of a DC signal output from the detecting means (3). Accordingly, the absolute value calculating element recited in the pending claims basically converts an AC signal applied to the electrostrictive elements (1) into a DC signal that is outputted from the piezoelectric/electrostrictive element of the detecting means (3). As claim 1 specifically recites, the alternating signal applied to the electrostrictive elements deforms those elements, and that deformation is converted into an electric signal using the detecting means (3).

No such structure is disclosed or suggested in Weiss. Specifically, Weiss discloses a voltage monitor that detects voltage generated from deforming a piezoelectric element using an optical strain gauge 45. As explained in detail in column 5, line 39--column 6, line 5, a piezoelectric substrate 40 is deformed by applying a voltage thereto. The deformation in the piezoelectric substrate 40 is detected by the crystalline optical strain gauge 45, in that the deformation changes the manner in which light is transmitted through the strain gauge 45. This change in light transmission is detected using optical fibers (50, 60) and a known optical detector (65).

Contrary to the presently claimed invention, the voltage monitor in Weiss converts a physical deformation in the piezoelectric substrate 40 into an *optical* signal, not an electric signal as presently claimed. For this reason alone, the rejection of the pending claims based on Weiss should be withdrawn.

In addition to the above, the detecting means used in the present invention is patentably distinct from the detecting means disclosed in Weiss. Under 35 USC §112, sixth paragraph, the PTO must review the present specification to determine the structure responsible for performing the "detecting means" function recited in the pending claims. The specification shows that the detecting means incorporates an electromechanical device, such as a piezoelectric/electrostrictive element. Deformation induced in the element produces a DC voltage signal, not an optical signal as in the case of the detecting means disclosed in Weiss.

For all the foregoing reasons, Applicants respectfully submit that all pending claims herein define patentable subject matter over the art of record. Accordingly, reconsideration and withdrawal of all grounds of rejection based on the art of record are respectfully requested.

For all the foregoing reasons, Applicants respectfully submit that this patent application is in condition for allowance. Should the Examiner deem that any further action by the Applicants would be desirable in placing this application in even better condition for issue, the Examiner is requested to telephone Applicants' undersigned representative.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

June 17, 2002
Date

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1. (Amended) An absolute value calculating element comprising electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating signal to ~~the~~ said electrostrictive elements ~~for deforming~~to deform the same and by converting a distortion of ~~the~~ said electrostrictive elements into an electric signal by using ~~the~~ said detecting means.

2. (Amended) ~~An~~ The absolute value calculating element ~~in which a~~of Claim 1, wherein said detecting means comprises a piezoelectric/electrostrictive element ~~is provided in the absolute value calculating element as recited in Claim 1~~ that is deformed in proportion to the amount of said deformation of ~~the~~ said electrostrictive elements, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating signal to ~~the~~ said electrostrictive elements ~~for deforming~~to deform the same and by outputting an electromotive force generated by the deformation of ~~the~~ said piezoelectric/electrostrictive element.

3. (Amended) The absolute value calculating element ~~as recited in~~of Claim 2, wherein ~~the~~ said electrostrictive elements and ~~the~~ said piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed.

4. (Amended) The absolute value calculating element ~~as recited in~~of Claim 2, wherein one end of ~~the~~ said electrostrictive elements is fixed in a deforming direction thereof ~~is fixed~~ while the other end of ~~the~~ said electrostrictive elements is fixedly attached to one surface of an elastic plate body, ~~which~~ having one fixed end ~~is fixed~~ and its ~~other~~another free end ~~is formed as a free end~~, and ~~a~~ said ~~plate-like~~

VERSION WITH MARKINGS TO SHOW CHANGES MADE
Amended Claims

piezoelectric/electrostrictive element is plate-shaped and is fixedly attached to the other surface of ~~the~~ said elastic plate body.

5. (Amended) The absolute value calculating element ~~as recited in~~of Claim 24, wherein ~~the~~ said electrostrictive elements and ~~the~~ said piezoelectric/electrostrictive element are formed ~~to assume~~in a plate-like shape, wherein ~~the~~ said electrostrictive elements are fixedly attached to one surface of ~~the~~ said ~~plate-like~~ elastic plate body while ~~the~~ said piezoelectric/electrostrictive element is fixedly attached to the ~~an~~ opposing surface of ~~the~~ said ~~plate-like~~ elastic plate body.

VERSION WITH MARKINGS TO SHOW CHANGES MADE
Amended Claims

In the Abstract:

The Abstract has been amended as follows:

Abstract

A sensor element formed of PZT is overlapped onto an actuator formed of electrostrictive elements, and both members are pinched between a rigid body that is not deformed~~: by~~. By impressing an alternating-current signal to the actuator, the sensor element is deformed in accordance with ~~an~~ the amount of deformation thereof ~~for utilizing~~ to use the thus generated electromotive force of the sensor element as a signal for the absolute value calculation.

VERSION WITH MARKINGS TO SHOW CHANGES MADE
Abstract

In the Abstract:

Please replace the abstract with the following:

Abstract

A sensor element formed of PZT is overlapped onto an actuator formed of electrostrictive elements, and both members are pinched between a rigid body that is not deformed. By impressing an alternating-current signal to the actuator, the sensor element is deformed in accordance with the amount of deformation thereof to use the thus generated electromotive force of the sensor element as a signal for the absolute value calculation.

SUBSTITUTE ABSTRACT

O.K. to enter
6/28/2002
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Absolute Value Calculating Element For Converting AC Signals into DC Signals

Field of the Invention

[0001] The present invention relates to an absolute value calculating element for converting alternating-current signals into direct-current signals.

Background of the Invention

[0002] Conventionally known absolute value calculating means for performing an absolute value calculation of alternating voltage (AC) signals and converting the same into direct-current voltage (DC) signals include full-wave rectification circuits arranged by assembling diodes, or circuits in which such circuits are combined with transformers.

[0003] However, it is sufficient to provide a single diode in the case of performing half-wave rectification in such a circuit employing diodes, when remaining half-waves will not be output but ignored. On the other hand, a plurality of elements to be imposed will be required in the case of forming a circuit in which full-wave rectification is performed so that forming the circuit will be troublesome. Moreover, while both of these circuits enable conversion in an effective manner since electric signals are directly converted into electric signals, forward voltage drops due to the diodes will not be zero, so that it may cause errors in the case of performing an absolute value calculation of minute signals using diodes.

[0004] The present invention has thus been made in view of these problems, and it is an object thereof to provide an absolute value calculating element for converting

SUBSTITUTE SPECIFICATION
Appendix A

alternating-current signals into direct-current signals having a small amount of imposed elements and without causing a specific voltage drop.

Summary of the Invention

[0005] For solving the above object, the present invention is provided with electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive elements to deform the same and by converting a distortion of the electrostrictive elements into an electric signal using the detecting means.

[0006] According to another embodiment of the present invention, a piezoelectric/electrostrictive element is provided that is deformed in proportion to the amount of deformation of the electrostrictive elements, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive element to deform the same and by outputting the electromotive force generated by the deformation of the piezoelectric/electrostrictive element.

[0007] The electrostrictive elements and the piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed. Further, one end of the electrostrictive elements is fixed in a deforming direction thereof, while the other end of the electrostrictive element is fixedly attached to one surface of an elastic plate body. One end of the elastic plate body is fixed and the other end is formed as a free end, and a plate-like piezoelectric/electrostrictive element is fixedly attached to the other surface of the elastic plate body.

[0008] Further still, the electrostrictive elements and the piezoelectric/electrostrictive element are formed to assume a plate-like shape, wherein the electrostrictive elements are fixedly attached to one surface of the plate-like elastic plate body, while the piezoelectric/electrostrictive element is fixedly attached to the opposing surface of the plate-like elastic body.

Brief Description of the Drawings

[0009] Fig. 1 is an explanatory view showing one example of an absolute value calculating element according to an embodiment of the present invention.

[0010] Fig. 2 is a view showing the characteristics of impressed voltage-deformation of the electrostrictive elements.

[0011] Fig. 3 is an explanatory view showing another embodiment of the present invention.

[0012] Fig. 4 is an explanatory view showing still another embodiment of the present invention.

Detailed Description of the Invention

[0013] Embodiments for materializing the present invention will now be explained with reference to the drawings. Fig. 1 is a schematic view showing one example of an absolute value calculating element according to the present invention, wherein an actuator 2 of substantially columnar shape is formed by overlapping a plurality of disk-like shaped electrostrictive elements 1, and a sensor element 3 of substantially identical shape is provided in an overlapping manner to be succeeding to the actuator 2. Both the actuator 2 and the sensor element 3 are pinched between a rugged rigid body 4 that will not be

deformed, and the sensor element 3 is provided to be deformable in accordance with deformations in the actuator 2, such that a dimension "t" in an entire height direction, as illustrated in Fig. 1, becomes constant. An alternating signal source 5 is connected to each of the electrostrictive elements 1 of the actuator 2 so that the electromotive force of the sensor element 3 will be extracted.

[0014] It should be noted that the sensor element 3 is preferably a piezoelectric element, e.g. a PZT material. It is alternatively possible to employ, instead of such an element utilizing piezoelectric effects, elements exhibiting piezoresistant effects such as a semiconductor gauge, an element utilizing magnetoresistant effects, a differential transformer, an eddy-current sensor, an element for detecting variations in capacities, or an electrostrictive element. Moreover, the actuator 2 may be a conventionally known MLP, in which a plurality of electrostrictive elements are formed to assume a laminated structure. However, in the case a piezoelectric element (formed of ceramics, such as PZT) is to be used as the sensor element, the actuator may be similarly formed of ceramics, such that both members may be integrally formed in a simple and effective manner.

[0015] Since the electrostrictive elements 1 are deformed in an identical direction upon receipt of positive/negative voltage signals as illustrated in the characteristics of the impressed voltage-deformation of Fig. 2, the actuator 2 will be accordingly deformed in an identical direction upon impressing positive/negative voltage signals to perform the absolute value calculating actions. Thus, an electric signal such as electromotive force, that is expressed as an absolute value will be generated from the sensor element deformed in accordance with the actuator 2.

[0016] Since the absolute value calculation of alternating-current signals may be performed by an integrally formed element, high-integration is enabled without the

necessity of arranging a different circuit, and the output of the absolute values of favorable characteristics may be obtained with small input signals since electrostrictive elements do not exhibit threshold characteristics, such as forward voltage drop as is the case with diodes.

[0017] Since the arrangement does not perform direct conversion of electric signals to electric signals, inputs and outputs may be electrically isolated from each other so that no conducting condition will be generated between inputs and outputs, even in the case of degradation or damage of the elements. It is further possible to provide a mechanism that does not respond to high frequencies, since mechanical displacements are interposed, and it is accordingly possible to incorporate functions of a low pass filter.

[0018] Fig. 3 illustrates another embodiment, in which a fixed bottom surface 7a and a wall surface 7b are provided onto which bottom surface 7a the actuator 2 is fixed. The upper surface 2a is fixedly attached to a rear surface of an elastic plate-like body 8, with one end thereof being fixed to the wall surface, and a plate-like sensor element 9 is fixedly attached to an upper surface of the plate-like body 8. The sensor element 9 may be preferably comprised of a piezoelectric unimorph.

[0019] Also with this arrangement, deformation of the actuator 2 causes deflection of the plate-like body 8 so that the sensor element 9 is accordingly deformed or distorted through the deflection to thus generate an electromotive force. It is thus possible to perform the absolute value calculation of the alternating voltage signals and to output the absolute value signals. It should be noted that the plate-like body 8 may be a metallic plate or formed of resin or ceramics.

[0020] In the case when the elastic plate-like body is interposed, an actuator 10 may be similarly formed to assume a plate-like shape in addition to the sensor element 9,

as illustrated in Fig. 4. In this manner, the entire absolute value calculating element may be manufactured in a simpler manner.

[0021] To obtain a sufficient amount of deformation of the actuator 2, alternating-current signals to be input are amplified using an operational amplifier or the like, such that output signals expressed as absolute values and having high S/N ratios may be obtained.

[0022] As explained above in detail, the present invention enables the performance of an absolute value calculation of alternating-current signals by using an integrally formed element and enables high-integration without the necessity of providing a peripheral circuit. Though diodes would cause voltage drop though it may be a forward one, a piezoelectric/electrostrictive element will not exhibit such threshold-like characteristics so that it is possible to perform the absolute value calculation in a favorable manner and with small signals. Since no direction conversion of electric signals into electric signals is performed, the input and output may be electrically isolated.

~~Specification~~

Absolute Value Calculating Element For Converting AC Signals into DC Signals

Field of the Invention

[0001] The present invention relates to an absolute value calculating element for converting alternating-current signals into direct-current signals.

~~Description~~ Background of the ~~Prior Art~~ Invention

[0002] Conventionally known absolute value calculating means for performing an absolute value calculation of alternating voltage (AC) signals and converting the same into direct-current voltage (DC) signals ~~are~~ include full-wave rectification circuits arranged by assembling diodes, or circuits in which such circuits are combined with transformers.

[0003] However, it ~~will be suffice~~ is sufficient to provide a single diode in the case of performing half-wave rectification in such a circuit employing diodes, ~~while~~ when remaining half-waves will not be output but ignored. On the other hand, a plurality of elements to be imposed will be required in the case of forming a circuit in which full-wave rectification is performed so that forming the circuit will be troublesome. Moreover, while both of these circuits enable conversion in an effective manner since electric signals are directly converted into electric signals, forward voltage ~~drop owing~~ drops due to the diodes will not be zero, so that it may cause errors in the case of performing an absolute value

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Appendix B

calculation of minute signals ~~by~~ using diodes.

[0004] The present invention has thus been made in view of these problems, and it is ~~a subject~~ an object thereof to provide an absolute value calculating element for converting alternating-current signals into direct-current signals ~~with~~ having a small amount of imposed elements and without causing a specific voltage drop.

Summary of the Invention

[0005] For solving the above ~~subject~~object, the present invention ~~of Claim 1~~ is provided with electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive elements ~~for deforming~~ to deform the same and by converting a distortion of the electrostrictive elements into an electric signal ~~by~~ using the detecting means.

[0006] ~~In~~ According to another embodiment of the present invention ~~of Claim 2~~, a piezoelectric/electrostrictive element is provided that is deformed in proportion to the amount of deformation of the electrostrictive elements ~~in the invention of Claim 1~~, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive element ~~for deforming~~ to deform the same and by outputting the electromotive force generated by the deformation of the piezoelectric/electrostrictive element.

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[0007] ~~In the invention of Claim 3, the~~ The electrostrictive elements and the piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed ~~in the invention of Claim 2. In the invention of Claim 1~~ Further, one end of the electrostrictive elements is fixed in a deforming direction thereof, ~~is fixed~~ while the other end of the electrostrictive element is fixedly attached to one surface of an elastic plate body, ~~which one~~. One end of the elastic plate body is fixed and ~~its~~ the other end is formed as a free end, and a plate-like piezoelectric/electrostrictive element is fixedly attached to the other surface of the elastic plate body ~~in the invention of Claim 2~~.

[0008] ~~In the invention of Claim 5~~ Further still, the electrostrictive elements and the piezoelectric/electrostrictive element are formed to assume a plate-like shape ~~in the invention of Claim 2~~, wherein the electrostrictive elements are fixedly attached to one surface of the plate-like elastic plate body, while the piezoelectric/electrostrictive element is fixedly attached to the ~~an~~ opposing surface of the plate-like elastic body.

Brief ~~Explanation~~ Description of the Drawings

[0009] Fig. 1 is an explanatory view showing one example of an absolute value calculating element ~~of~~ according to an embodiment of the present invention.

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present invention.

[0012] Fig. 4 is an explanatory view showing still another embodiment of the present invention.

Detailed Description of the ~~Preferred Embodiments~~Invention

[0013] Embodiments for materializing the present invention will now be explained with reference to the drawings. Fig. 1 is a schematic view showing one example of an absolute value calculating element according to the present invention, wherein an actuator 2 of substantially columnar shape is formed by overlapping a plurality of disk-like shaped electrostrictive elements 1, and a sensor element 3 of substantially identical shape is provided in an overlapping manner to be succeeding to the actuator 2. Both ~~of~~ the actuator 2 and the sensor element 3 are pinched between a rugged rigid body 4 that will not be deformed, and the sensor element 3 is provided to be deformable in accordance with deformations in the actuator 2, such that a dimension ~~t~~ "t" in an entire height direction, as illustrated in Fig. 1, becomes constant. An alternating signal source 5 is connected to each of the electrostrictive elements 1 of the actuator 2 so that the electromotive force of the sensor element 3 will be extracted.

[0014] It should be noted that the sensor element 3 ~~be~~ is preferably a piezoelectric element, e.g. ~~of~~ a PZT material~~.~~ ~~It~~ It is alternatively possible to employ, instead of such an element utilizing piezoelectric effects, elements exhibiting piezoresistant effects such as a semiconductor gauge, an element utilizing magnetoresistant effects, a differential transformer, an eddy-current

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[0016] Since the absolute value calculation of alternating-current signals may be performed by an integrally formed element, high-integration is enabled without the necessity of arranging a different circuit, and the output of the absolute values of favorable characteristics may be obtained with small input signals since electrostrictive elements do not exhibit threshold characteristics, such as forward voltage drop as ~~it~~ is the case with diodes.

[0017] Since the arrangement does not perform direct conversion of electric signals to electric signals, inputs and outputs may be electrically isolated

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from each other so that no conducting condition will be generated between inputs and outputs, even in the case of ~~degradation, degradation~~ or ~~damage, damage~~ of the elements. It is further possible to provide a mechanism that does not respond to high frequencies, since mechanical displacements are interposed, and it is accordingly possible to incorporate functions of a low pass filter.

[0018] Fig. 3 illustrates another embodiment, in which a fixed bottom surface 7a and a wall surface 7b are provided onto which bottom surface 7a the actuator 2 is fixed. ~~Its~~ The upper surface 2a is fixedly attached to a rear surface of an elastic plate-like body 8, with one end thereof being fixed to the wall surface, and a plate-like sensor element 9 is fixedly attached to an upper surface of the plate-like body 8. The sensor element 9 may be preferably comprised of a piezoelectric unimorph.

[0019] Also with this arrangement, deformation of the actuator 2 causes deflection of the plate-like body 8 so that the sensor element 9 is accordingly deformed or distorted through the deflection to thus generate an electromotive force. It is thus possible to perform the absolute value calculation of the alternating voltage signals and to output the absolute value signals. It should be noted that the plate-like body 8 may be a metallic plate or formed of resin or ceramics.

[0020] In the case when the elastic plate-like body is interposed, an actuator 10 may be similarly formed to assume a plate-like shape in addition to the sensor element 9, as illustrated in Fig. 4. In this manner, the entire absolute value calculating element may be manufactured in a simpler manner.

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[0021] ~~For obtaining~~ To obtain a sufficient amount of deformation of the actuator 2, alternating-current signals to be input ~~shall be~~ are amplified ~~by~~ using an operational amplifier or the like, such that output signals expressed as absolute values and having high S/N ratios may be obtained.

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